We Claim as Our Invention

1. An implantable heart stimulating device comprising:

a first pacing circuit adapted to be connected to a first pacing electrode suited to be positioned to interact with a first ventricle of a heart to receive signals from the first pacing circuit to pace the first ventricle with pacing pulses having an energy;

a first sensing circuit adapted to be connected to a first sensing electrode suited to be positioned to interact with the first ventricle of the heart to transfer signals to the first sensing circuit to sense the first ventricle;

a second pacing circuit adapted to be connected to a second pacing electrode suited to be positioned to interact with a second ventricle of the heart to receive signals from the second pacing circuit to pace the second ventricle with pacing pulses having an energy;

a second sensing circuit adapted to be connected to a second sensing electrode suited to be positioned to interact with the second ventricle of the heart to transfer signals to the second sensing circuit to sense the second ventricle;

a control circuit connected to said first and second pacing circuits and to said first and second sensing circuits;

said control circuit and the first sensing circuit detecting a signal typical of an evoked response to a pacing pulse delivered by the first pacing circuit, by sensing within a first time interval

that follows after a pacing pulse delivered by the first pacing circuit;

said control circuit and said first sensing circuit also detecting, within a first time window, a signal typical for an R-wave transferred from the second ventricle, or from some other part of the heart, to the first ventricle, wherein said first time window is not identical with the first time interval;

the control circuit operating with time cycles corresponding to normal heart cycles;

the control circuit, if within one of said time cycles pacing pulses are delivered both by the first pacing circuit and by the second pacing circuit, determining these pacing pulses to have been delivered substantially simultaneously;

said control circuit

(a) determining whether during a time cycle the signal typical of an evoked response to a pacing pulse delivered by the first pacing circuit is sensed within the first time interval, and

(b) determining whether during the same time cycle the signal of the kind typical for an R-wave transferred from the second ventricle, or from some other part of the heart, to the first ventricle is detected within the first time window, and

said control circuit operating at least said first and second pacing circuits dependent on whether (a) and (b) are fulfilled.

2. An implantable heart stimulating device according to claim 1, wherein the control circuit operates at least said first and second pacing circuits in a first manner if both (a) is not fulfilled and (b) is fulfilled, and in a second manner if both (a) is not fulfilled and (b) is not fulfilled.

3. An implantable heart stimulating device according to claim 2, wherein the control circuit in said first manner operates at least said first and second pacing circuits as if a real loss of capture has occurred in the first ventricle and in said second manner as if fusion has occurred in the first ventricle.

4. An implantable heart stimulating device according to claim 3, wherein the control circuit, if both (a) is not fulfilled and that (b) is fulfilled has occurred a predetermined number of times, varies the energy of the pacing pulses delivered by the first pacing circuit and detects, with the first sensing circuit, signals typical for evoked responses during the first time interval to determine a suitable pulse energy for the pacing pulses delivered by the first pacing circuit.

5. An implantable heart stimulating device according to claim 3, wherein the control circuit, if both (a) is not fulfilled and (b) is not fulfilled has occurred a predetermined number of times, modifies at least one time period that controls the operation of at least said first and second pacing circuits.

6. An implantable heart-stimulating device according to claim 5, wherein the control circuit modifies said time period by increasing or decreasing said time period.

7. An implantable heart stimulating device according to claim 1, wherein the control circuit starts said first time interval 0-3 ms after delivery of a pacing pulse by the first pacing circuit and sets said first time interval to be between 25ms and 100ms long.

8. An implantable heart stimulating device according to claim 7, wherein the control circuit starts said first time window between 0 ms and 150 ms after the delivery of the pacing pulse by the first pacing circuit.

9. An implantable heart stimulating device according to claim 7, wherein the control circuit ends said first time window at least before 400ms after the delivery of the pacing pulse by the first pacing circuit.

10. An implantable heart stimulating device according to claim 7, wherein said control circuit includes a blanking window in said first time window in which sensing or an R-wave transferred from said second ventricle, or from some other part of the heart, is precluded.

11. An implantable heart stimulating device according to claim 1 wherein

said control circuit and said second sensing circuit detect a signal typical of an evoked response to a pacing pulse delivered by the second pacing circuit, by sensing within a second time interval that follows after a pacing pulse delivered by the second pacing circuit;

said control circuit and said second sensing circuit detect, within a second time window, a signal of the kind typical for an R-

wave transferred from the first ventricle, or from some other part of the heart, to the second ventricle, wherein this second time window is not identical with the second time interval;

said control circuit

(c) determines whether during a time cycle the signal typical of an evoked response to a pacing pulse delivered by the second pacing circuit is sensed within the second time interval, and

(d) determines whether during the same time cycle the signal of the kind typical for an R-wave transferred from the first ventricle, or from some other part of the heart, to the second ventricle is detected within the second time window; and

said control circuit operates at least said first and second pacing circuits also dependent on whether (c) and (d) are fulfilled.

12. An implantable heart stimulating device according to claim 11, wherein the control circuit operates at least said first and second pacing circuits in a first manner if both (c) is not fulfilled and (d) is fulfilled, and in a second manner if both (c) is not fulfilled and (d) is not fulfilled.

13. An implantable heart stimulating device according to claim 12, wherein the control circuit in said first manner operates at least said first and second pacing circuits as if a real loss of capture has occurred

in the second ventricle and in said second manner as if a fusion has occurred in the second ventricle.

14. An implantable heart stimulating device according to claim 13, wherein the control circuit, if both (c) is not fulfilled and (d) is fulfilled has occurred a predetermined number of times, varies the energy of the pacing pulses delivered by the second pacing circuit and detects, with the second sensing circuit, signals typical for evoked responses during the second time interval to determine a suitable pulse energy for the pacing pulses delivered by the second pacing circuit.

15. An implantable heart stimulating device according to claim 13, wherein the control circuit, if both (c) is not fulfilled and (d) is not fulfilled has occurred a predetermined number of times, modifies at least one time period that controls operation of at least said first and second pacing circuits.

16. An implantable heart stimulating device according to claim 15, wherein said control circuit modifies said time period by increasing or decreasing said time period.

17. An implantable heart stimulating device according to claim 1 wherein the control circuit starts said second time interval 0-30ms after delivery of a pacing pulse by the second pacing circuit (19) and sets said second time interval to be between 25ms and 100ms long.

18. An implantable heart stimulating device according to claim 17 wherein the control circuit starts said second time window between 0 ms and 150 ms after delivery of said pacing pulse by the second pacing circuit (19).

19. An implantable heart stimulating device according to claim 18, wherein the control circuit ends said second time window at least before 400ms after delivery of the pacing pulse by the second pacing circuit.

20. An implantable heart stimulating system comprising:

a first pacing circuit that generates pacing pulses having an energy;

a first pacing electrode suited to be positioned to interact with a first ventricle of a heart and connected to said first pacing circuit to receive signals from the first pacing circuit to pace the first ventricle with said pacing pulses generated by said first pacing circuit;

a first sensing circuit;

a first sensing electrode suited to be positioned to interact with the first ventricle of the heart and connected to the first sensing circuit to transfer signals to the first sensing circuit to sense the first ventricle;

a second pacing circuit that generates pacing pulses having an energy;

a second pacing electrode suited to be positioned to interact with a second ventricle of the heart and connected to said second pacing circuit to receive signals from the second pacing circuit to pace the second ventricle said pacing pulses generated by said second pacing circuit;

a second sensing circuit;

a second sensing electrode suited to be positioned to interact with the second ventricle of the heart and connected to the second sensing circuit to transfer signals to the second sensing circuit to sense the second ventricle;

a control circuit connected to said first and second pacing circuits and to said first and second sensing circuits;

said control circuit and the first sensing circuit detecting a signal typical of an evoked response to a pacing pulse delivered by the first pacing circuit, by sensing within a first time interval that follows after a pacing pulse delivered by the first pacing circuit;

said control circuit and said first sensing circuit also detecting, within a first time window, a signal typical for an R-wave transferred from the second ventricle, or from some other part of the heart, to the first ventricle, wherein said first time window is not identical with the first time interval;

the control circuit operating with time cycles corresponding to normal heart cycles;

the control circuit, if within one of said time cycles pacing pulses are delivered both by the first pacing circuit and by the second pacing circuit, determining these pacing pulses to have been delivered substantially simultaneously;

said control circuit

(a) determining whether during a time cycle the signal typical of an evoked response to a pacing pulse delivered by the first pacing circuit is sensed within the first time interval, and

(b) determining whether during the same time cycle the signal of the kind typical for an R-wave transferred from the second ventricle, or from some other part of the heart, to the first ventricle is detected within the first time window, and

said control circuit operating at least said first and second pacing circuits dependent on whether (a) and (b) are fulfilled.

21. An implantable heart stimulating system according to claim 20, wherein the first sensing electrode is the same electrode as the first pacing electrode and wherein the second sensing electrode is the same electrode as the second pacing electrode.

22. An implantable heart stimulating system according to claim 20 wherein

said control circuit and said second sensing circuit detect a signal typical of an evoked response to a pacing pulse delivered by the second pacing circuit, by sensing within a second time

interval that follows after a pacing pulse delivered by the second pacing circuit;

said control circuit and said second sensing circuit detect, within a second time window, a signal of the kind typical for an R-wave transferred from the first ventricle, or from some other part of the heart, to the second ventricle, wherein this second time window is not identical with the second time interval;

said control circuit

(c) determines whether during a time cycle the signal typical of an evoked response to a pacing pulse delivered by the second pacing circuit is sensed within the second time interval, and

(d) determines whether during the same time cycle the signal of the kind typical for an R-wave transferred from the first ventricle, or from some other part of the heart, to the second ventricle is detected within the second time window; and

said control circuit operates at least said first and second pacing circuits also dependent on whether (c) and (d) are fulfilled.

23. A method for treating a subject by biventricular cardiac stimulation comprising the steps of:

in a subject suffering from congestive heart failure, implanting a housing containing a first pacing circuit that generates pac-

ing pulses having an energy, a first sensing circuit, a second pacing circuit that generates pacing pulses having an energy, a second sensing circuit, and a control circuit connected to said first and second pacing circuits and to said first and second sensing circuits;

implanting a first pacing electrode to interact with a first ventricle of a heart of the subject and connecting said first pacing electrode to said first pacing circuit to receive signals from the first pacing circuit to pace the first ventricle with said pacing pulses generated by said first pacing circuit;

implanting a first sensing electrode to interact with the first ventricle of the heart of the subject and connecting said first sensing electrode to the first sensing circuit to transfer signals to the first sensing circuit to sense the first ventricle;

implanting a second pacing electrode to interact with a second ventricle of the heart of the subject and connecting said second pacing electrode to said second pacing circuit to receive signals from the second pacing circuit to pace the second ventricle said pacing pulses generated by said second pacing circuit;

implanting a second sensing electrode suited to interact with the second ventricle of the heart of the subject and connecting said second sensing electrode to the second sensing circuit

to transfer signals to the second sensing circuit to sense the second ventricle;

with said control circuit and the first sensing circuit, detecting a signal typical of an evoked response to a pacing pulse delivered by the first pacing circuit, by sensing within a first time interval that follows after a pacing pulse delivered by the first pacing circuit;

with said control circuit and said first sensing circuit, also detecting, within a first time window, a signal typical for an R-wave transferred from the second ventricle, or from some other part of the heart, to the first ventricle, wherein said first time window is not identical with the first time interval;

operating the control circuit with time cycles corresponding to normal heart cycles and, in the control circuit, if within one of said time cycles pacing pulses are delivered both by the first pacing circuit and by the second pacing circuit, determining these pacing pulses to have been delivered substantially simultaneously;

in said control circuit

(a) determining whether during a time cycle the signal typical of an evoked response to a pacing pulse delivered by the first pacing circuit is sensed within the first time interval, and

(b) determining whether during the same time cycle the signal of the kind typical for an R-wave transferred from the second ventricle, or from some other part of the heart, to the first ventricle is detected within the first time window, and

operating at least said first and second pacing circuits with said control circuit dependent on whether (a) and (b) are fulfilled.

24. A method as claimed in claim 23 comprising implanting said housing, said first and second pacing electrodes, and said first and second sensing electrode in a living subject suffering from a bundle branch block.

25. A method according to claim 23 comprising the steps of:

with said control circuit and said second sensing circuit, detecting a signal typical of an evoked response to a pacing pulse delivered by the second pacing circuit, by sensing within a second time interval that follows after a pacing pulse delivered by the second pacing circuit;

with said control circuit and said second sensing circuit detecting, within a second time window, a signal of the kind typical for an R-wave transferred from the first ventricle, or from some other part of the heart, to the second ventricle, wherein this second time window is not identical with the second time interval;

in said control circuit

(c) determining whether during a time cycle the signal typical of an evoked response to a pacing pulse delivered by the second pacing circuit is sensed within the second time interval, and

(d) determining whether during the same time cycle the signal of the kind typical for an R-wave transferred from the first ventricle, or from some other part of the heart, to the second ventricle is detected within the second time window; and

operating at least said first and second pacing circuits with said control circuit also dependent on whether (c) and (d) are fulfilled.